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ABSTRACT

Recent studies on schema theory and other concepts related to reading comprehension are discussed in this paper. Noting that the psycholinguistic model of reading views reading as a process of predicting meaning based on the reader's prior knowledge of language, the paper describes recent research that has led to a definition of reading comprehension that considers linguistic competencies, syntactic and semantic knowledge, and factors related to the printed page and to the reading environment. It then examines the characteristics of schemata, which represent generic concepts that are stored in memory, and explains how schema theory provides the concepts for explaining how readers interact with texts to interpret and comprehend. It provides examples to show how readers call upon schemata in reading and points out that in schema theory bottom up and top down processing of input occur simultaneously. Finally, the paper shows how schema theory points up the importance of such instructional methods as assisting students to relate new concepts to those already known, assisting them in setting up the dominant structure for comprehending a text, developing vocabulary concepts, and developing effective question/answer relationships. (GT)

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A Review of Research on Schema Theory and Its Implications for Reading Instruction in Secondary Reading

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After several decades of debating about phonics instruction, how much, when, and by what method of instruction, research and debates in reading have taken a new emphasis particularly in the past five years. Reading comprehension is finally being given the interest it has for so long deserved.

The traditional definition of comprehension, at least as it was interpreted by the authors and writers of basal readers and literature anthologies, resulted in the teaching of comprehension by "separately defined" reading comprehension skills, and could be called a Skills Model. Skills, separately taught in a logical and sequential order, was supposed to result in reading comprehension of textual material.

Instruction in comprehension usually consisted of asking students questions about what they had read; these questions usually generated, at best, along a taxonomic mode, frequently ? Bloom's Taxonomy of the Cognitive Domain.

About ten years ago a newer model of reading, the Psycholinguistic Model, began to assert that contrary to this view of reading as a sequence of skills which could be taught, reading was in actuality a process of predicting meaning based on the reader's knowledge of oral language syntax and semantics and phonological cues. In other words based on the reader's store of information about how language worked, (based on oral language) a reader already possessed some knowledge about how words were ordered and what kinds of meaning words possessed in certain contexts.

The great debates of late have argued for the efficacy of either one of these models, though at least some persons, (including myself) have perceived that both of these models have merit in terms

of instruction. Before discussing the newest model of reading comprehension, Schema Theory, I will first define the changes new research has made in the definition of reading comprehension. While parts of this definition may sound familiar, the emphasis has shifted, so that now the skills model theorists recognize the need for skills instruction in context (Otto), and psycholinguists recognize a greater need for readers to utilize grapho-phonemic knowledge as well as semantic and syntactic.

READING COMPREHENSION

Reading comprehension results from an interaction between the reader and the text, and by extension with the author of the text. At the highest level, the reader understands a passage both in terms of its impact on the reader and the meaning which the author intended by extracting meaning, implicit and explicit, from the written text using visual, linguistic, and conceptual information processing systems. (Adams and Collins)

Thus there are a set of preexisting conditions which influence the reader, and what he or she brings to the reading situation, as well as shaping the way in which comprehension takes place. At the most primitive level, the reader must perceive the figures on the paper to be read, not only as a sequence of letters, but as words which may have a variety of meanings depending on context. Thus the reader's language and concept development will effect reading comprehension. Other reader characteristics effecting comprehension are general knowledge and experience background, interests, motivation and purpose for reading, personal attitudes and beliefs, reading ability, including automaticity, (or the

ability to identify a word automatically) and linguistic knowledge and flexibility.

Some of these factors are included in Pearson's and Johnson's psycholinguistic view of factors influencing reading comprehension. They specify inside and outside the head factors. Included in their view of inside the head factors influencing reading comprehension they mention interest, motivation, and reading ability while explaining in depth the linguistic competence a reader uses in reading comprehension. These linguistic competencies include phonological knowledge which includes sound-symbol correspondences, as well as the readers knowledge of pitch (intonation), stress (emphasis), and juncture (I scream; ice cream).

The second area of linguistic competency is the syntactic knowledge the reader employs in comprehension. Readers, as well as listeners, are receivers of language. In both cases the competent listener or the reader is able to predict from a fairly limited range of words, the function of a word relative to the other words in a sentence. The reader is able to do this through his or her oral language knowledge.

As well as a syntactic tie to oral language, reading has a semantic relation as well. The reader employs semantic information, or knowledge of what words can mean and how they are related to one another, in order to predict the meaning of a word in context. This prediction, or reduction of uncertainty, (Smith, 1975) enables the reader to eliminate unlikely alternatives from a given context.

Thus in the psycholinguistic model the reader utilizes all three systems in order to predict and comprehend using the semantic and syntactic to predict and verifying through the phonological or grapho-phomenic input. (Pearson, 1978)

Outside the head factors which influence reading comprehension are those related to the printed page, the qualities of the reading environment and the school environment. (Pearson and Johnson, 1978) The page or written message is specified in several parts: the words, their frequency and abstractness; sentences, their length and complexity; and beyond sentences including discourse analysis involving relationships between sentences, between paragraphs, identifiable story structures, and the way in which material is organized. Pearson and Johnson emphasize that comprehension at the longer discourse level is more difficult than at the proposition, clause or sentence level, because of the necessity of making inferences from sentences which are textually further apart.

The following definition of comprehension from Pearson and Johnson reflects not only a psycholinguistic perspective but the most research influence on comprehension from the fields of cognitive psychology and research on artificial intelligence stemming from computer simulation of mental processes:

> Comprehension involves 1) processing the text information, 2) matching it against the prototypic script for such events, 3) integrating textual and scriptal (our coined word) information, thus producing a complete knowledge structure for the event described in the text. p. 46

This interface of disciplines - linguistics, cognitive psychology and artificial intelligence has resulted in a new perspective on reading, and the emergence of a new discipline,

Cognitive Science. (Rummelhart and Ortony).

SCHEMA THEORY

Pearson and Johnson's use of the word, "script," reflects the influence of this new discipline. They have defined "script" as a special label for experience which is stored in our knowledge system. This system for storing and retrieving knowledge in memory is also called schema theory. Schemata, (the plural form) according to Rummelhart and Ortony, represent generic concepts which are stored in memory. These generic concepts include concepts underlying objects, situations, events, actions, and sequences of actions. These objects etc. are not atomic, but contain the network of interrelations with other constituent concepts. In other words, the way in which a particular concept is stored is not by remembering that isolated event in its totality down to its most basic components, but by identifying those aspects of the event related to other concepts already stored. In effect we make corrections between the information in the text and what we already know. Thus schemata represent stereotypes of concepts. A particular schema would be analogous to play with interal structure corresponding to the script of the play. (Rummelhart and Ortony) So a schema represents generalized knowledge about a sequence of events and, like a play has a cast of characters and a sequence of scenes, a schema has its parts and sequences of events. Rummelhart explains:

> Imagine that we have within our memories, schemata ... for every more or less standardized sequence of events that we know about. In this case, comprehension consists of finding a schema that fits the situation (or story) we are trying to understand and discovering, who, if anyone, in the story corresponds to the required characters. (p. 165)

The underlying assumption of schema theory is that the written text does not in itself convey the meaning, but interacts with the previously acquired knowledge of the reader in retrieving or reconstructing meaning. The goal of schema theory is to map this interaction between textual information and the reader's schema, specifying how knowledge is shaped and stored. (Adams and Collins)

Schemata have four essential characteristics. 1) They have variables or slots, 2) they can embed within one another, 3) they represent generic concepts which vary in their levels of abstraction, and 4) they represent knowledge rather than definitions. (Rummelhart and Ortony)

Using the play analogy, the variables in a schema tell us what kind of persons can conceivably fit or be bound to a certain role based on the context and situation of the play or schema. When we do not have sufficient information as to the exact fit we can assign default values based on inferences, or make good guesses which are closer to the average than on one or the other extreme of the range of variables. When are able to assign or bind a variable based on the situation, memory or default, the schema is said to have been instantiated, the first step in comprehension. (Rummelhart and Ortony)

For example, words do not have a single meaning, but have many possible meanings from which the reader must determine when encountering that word in a given context. When the reader infers the meaning of the word from context, and the slot has been filled with a particular case or meaning, instantiation has occurred. We must fill the slots in order to interpret the message.

We comprehend the message in a text when we are able to call up the appropriate schema which allows us to place the information in the text into the appropriate slots--fitting it into an interpretation which allows us to see the text in a certain way. What we store is the interpretation of the text which we then call up to make inferences about author's purpose, specific characters, and so on in other similar texts.

Anderson and others conducted a series of experiments to investigate whether general terms, words, or concepts were more effective in recalling sentences, than an inferred instantiation of the term. An example sentence which was presented to the subjects was "The woman was outstanding in the theater." The results of the experiment indicated that a particular term, "actress," was a better cue for the recall of the sentence than the word, "woman," even though "woman" had appeared in the sentence and "actress" had not. Consistent with schema theory, the experimenters theorized that the subjects had instantiated the word "actress" since it provided the most coherent interpretation of the message. (Anderson and others, March, 1976)

In other words, the schema contain slots, or places for each component, and encoding is a matter of filling slots in the schema with aspects of the object or event. These slots are often filled by inference. (Anderson, July, 1977)

The second essential characteristic of schemata is that they can be embedded within one another. (Embedded schemata are called sub-schemata.) The structure of a schema is understood in terms of its relationships with other schema, so that the schema used to

understand a particular text will contain sub-schemata or embedded schemata in a hierarchical form. The position of embedded schemata in this hierarchy is often related to its index of importance so that the schema could be said to "give" such information its importance by instantiating higher order slots based on significant text information. Schema are more likely to contain concepts for reconstructing or retrieving important rather than unimportant elements. (Anderson, July, 1977).

The third and fourth characteristics of schemata are that they can be at all levels of abstraction and they represent knowledge rather than definitions. Schema can range in a hierarchy from the most encyclopedic, symbolic, and conceptual to the most atomistic.

Schema theory provides us with the concepts and vocabulary to make predictions what takes place during reading. According to this theory when we read we select the appropriate schema and variables or slots which fill the particular cases so that we can "account for" the material to be comprehended, and then verify that those schemata do indeed account for it. (Rummelhart and Ortony, p. 111)

Generalized schema allow us to learn or make sense of a wide array of information or very abstract ideas, and these generalized schema can be modified or adapted as we learn new information. (Abstracted knowledge based on memories of concepts are called generic knowledge.) This idea is very closely related to the Piagetian concepts of assimilation and accommodation. Assimilation takes place when new knowledge is integrated into a preexisting knowledge base. Accommodation occurs when the knowledge base, or schema is changed in order to fit in new information.

We can also construct very specific schema to account for situations or events which occur frequently allowing us to process this information faster and easier by helping us focus on a pattern of elements which occur in the stored schema and in the text. (Stored memories of particular directly or indirectly experienced events are called episodic memories.)

For example if we are reading a story about two people going to a movie, we can retrieve from our knowledge bank our schema for going to a movie which includes things like buying a ticket, taking our seat, and the movie coming on. We might also call up embedded or sub-schemata such as stopping at the refreshment stand and watching the coming attractions. We can call up a complete scenario based on our past experiences of going to the movies which will influence our comprehension of the story about going to a movie. Based on our movie schema we could make inferences, or predictions about what usually occurs when people go to the movies. We may have a slot for buying something at the refreshment stand which could include variables such as drink, candy, or popcorn, though our default value for this slot would probably be popcorn - the most predictable item.

In one experiment subjects read either a story about two people eating in a restaurant or shopping in a supermarket. The same food items were mentioned in both stories. Those subjects who read the restaurant story were better able to recall the foods which were most likely to be part of a restaurant schema and were more likely to remember who had ordered the food. In other words, when reading a story about eating in a restaurant it is more important to notice

who orders what, than when the same people are buying those items in a supermarket. This study offers some empirical support for schema theory. (Anderson, et. al., March, 1977)

PROCESSING INPUT

The traditional skills model view of reading is a bottom up or data driven processing model. In this view of reading, letters are perceived in a left to right sequence until a word is perceived as a whole, meaning is obtained and related to other words in the sentence, and thus activating the dominant schema and its particular concepts.

The older psycholinguistic model is primarily a top down or conceptually driven model where the emphasis is on prediction of meaning. Ultimately it is the concepts which generate a search for the data or words to confirm these predictions. (Goodman, 1967)

In schema theory, bottom up and top down processing of input or information occur simultaneously and at all levels of abstraction which allow the perceptual elements of word recognition and higher order schemata to coalesce into a theory providing for the conceptualization of interrelations between levels of processing. (Adams and Collins)

Rummelhart and Ortony summarize the essence of this processing by stating that "information (including both the "stimulus" and the context) enters the system and directly suggests certain plausible candidate schemata to account for it." (p. 130) Thus a possible schema needs to find good bindings for its variables, some evidence for its sub-schemata, and a dominating schema which to some extent offers a good fit.

Reiterating, schema theory provides the concepts and the theory for explaining how the reader interacts with the text to interpret and comprehend. This interpretation is influenced by the reader's background, personal history, knowledge and beliefs which are brought to bear in constructing schemata to provide the interpretative framework for comprehending discourse to the extent that a reader may perceive only one interpretation for a text to the exclusion of other possible interpretations. (Anderson, July, 1976)

Anderson and others conducted an experiment with college students from two different disciplines. Each group was asked to read two passages each of which was sufficiently ambiguous so that it could be interpreted in two different ways. Scores on multiple choice and other tests indicated that there was a striking relationship between their interpretation and their professional discipline. Most subjects were unaware that more than one interpretation was possible for each of the passages. The experimenters stated that the results indicated that high level schemata influenced the interpretation of these passages.

Schema serve as the basis for making inferences or reading between the lines and for making predictions based on observation of only part of the input. Schema also serve as the vehicles for searching memory for previously read material and reconstructing meaning.

IMPLICATIONS FOR INSTRUCTION

Returning for a moment to a definition of reading comprehension, we can see that schema theory has placed new emphasis on

various parts of older definitions, particularly the importance of the preexisting knowledge and schema of the reader, the purposes set for reading, the type of instruction and questions asked before and after reading textual material.

While we have always deplored the teacher who instructed students to "read from pages 91 to 124," the importance of motivating and building interest as well as pre-assessing the knowledge or schematic base of the reader is now dramatically more important in light of schema theory. If we are to help students to construct a framework for understanding discourse, or in Ausubel's terms (1963) aid the student in finding the appropriate "ideational scaffolding," we must assist students in relating new concepts to similar ones already known to them. Not only must we help students to search for experiences and concepts similar to those which occur in the texts they are to read, but we must help them become more aware of their personal attitudes and beliefs which can shape their interpretation of a text giving meaning unlike that which the author intended.

At a very general level, schema rely very heavily on predictable or stereotypic values for inference. The more fully developed the schema is, the more likely it is to resist change even in the face of evidence to the contrary. Anderson (1977) states that large scale schema change is possible, but will likely be resisted. Large scale schema change then is closely akin to a dialectical process, and socratic teaching which emphasizes questions dealing with counter-examples and contradictions is an effective method to facilitate this process.

Wyer's (1977) analysis of attitudes and beliefs on information acquisition supports this resistance to major cognitive reorganization based on new information. The reader then resists such major schematic change since it not only effects a particular schema but requires reexamination of all related sub-schemata. Such a change would be analogous to changing religions, political ideology, or one's view of women.

Thus in facilitating comprehension, the teacher must aid students in calling upon an existing schema to infer meaning, and when the existing schema is inappropriate to integrate the information in the text, how to modify this schema or shift gears to another more appropriate schema.

While teachers' guides have usually provided some purpose for students' reading, the merit of actually doing this becomes more obvious. It seems rather self evident that if we want students to comprehend a text in a particular way, that we should assist them in setting up the dominant structure for doing so. It should also be apparent that we cannot presume that students have schemata for all the possible purposes for reading, and need instruction which first provides those models or exemplars so that students can develop schemata which can be used as the basis for inferring when faced with the purpose in another context.

Vocabulary development should become more than introducing words, looking up definitions in the dictionary and using the words in sentences. Even with as simple a word as "dog" teachers can begin to develop related concepts. My dog, Shanti, is a specific example of a dog. He is also a German Shephard, belonging

to this class of dogs as opposed to being a dachshund, though both breeds are examples of different classes of dogs. Both of these breeds or classes of dogs share properties of things attributed to dogs like barking and having teeth. The concept of dog can be understood to be a class example of the higher order class of animal of which cats, and even gerbils are other class examples. Thus vocabulary development becomes more than learning "a" meaning for a word; it becomes (or at least should become) concept development. While we may begin at a concrete level, we should extend the word to its functional meaning, and then to an abstract level which would include all the possible meanings for the word.

Since Socrates (if not before) teachers have recognized the importance and value of questioning. To a more or less extent reading materials, as well as Barrett's Taxonomy of Reading Comprehension have attempted to define and generate questions at a variety of comprehension levels. These levels have referred to the literal, inferential, critical or evaluative, and appreciation levels among others. Anyone who has developed questions using Barrett's Taxonomy of Reading Comprehension soon realizes some problems. The structure of a comprehension taxonomy presupposes that higher order understandings are based on the acquisition of lower order knowledge. Yet students might be able to answer so-called higher order or evaluative questions about a text without recalling some literal facts in the story. In addition students might be asked a higher order question and respond with a low level response.

Pearson and Johnson have proposed a new taxonomy of questioning which appears to be based on schema theory. (1978) Their taxonomy

consists of only three levels or types of questions 1) those questions which are textually explicit and have an obvious answer right on the page; 2) questions which are textually implicit and have an answer on the page, but the answer is not quite so obvious; and 3) scriptually implicit, or more broadly, schematically implicit, where the reader needs to use his or her script or schema to come up with the right answer.

They are not classifying questions in this taxonomy, but the relations between questions and responses. In this manner they define a question-answer relationship as textually explicit if both the question and answer are derived from the text and the relationship between the question and answer was explicitly cued from the language of the text. They call this "reading on the lines." (p. 163)

A question-answer relationship is defined as textually implicit if both the question and answer are derived from the text, but there is no logical or grammatical cue tying them together. They call this "reading between the lines." (p. 163)

An interesting point is made with reference to understanding the main idea of a paragraph or longer selection. They argue against recognition or recall of main ideas at the literal level on Barrett's taxonomy, asserting that unless the author has explicitly stated that "the main idea is...", answering such a question would necessarily involve an inference.

They define a question-answer relationship as scriptually implicit if the reader has responded to a question inferring from information based on prior knowledge or existing scripts with similar concepts and not from what is on the page. They call this

"reading beyond the lines." (p. 164)

Comprehending textual material is a holistic process; and while teaching skills will still be part of helping student comprehend, the overlapping nature of these skills should be more apparent.

Hopefully the most significant result of recent research on comprehension would be to see the demise of the practice of teaching skills in isolation. Anyone who has worked with remedial readers has witnessed that some of them are unable to transfer the knowledge of skills developed in isolation into context while reading.

Another practice, the "Guess what I'm thinking" question needs to be joyously buried. Rather than students trying to figure out what is in the teacher's head, the teacher should be trying to assess what is in the student's head so that new material can be related to what is already known. For example, one teacher in a very small rural junior high school was having students read The Outsiders, a very popular book with students nowdays. However the students in this community had very little knowledge of inner city teenage problems, let along gang wars. Yet when it was discovered that many of the students had seen West Side Story on television, they were able to comprehend The Outsiders fairly easily even though the reading level was beyond what some of them could usually handle.

While the emphasis of this paper has been to examine the cognitive aspect of comprehending reading material, it is necessary to mention, however minimally, the affective dimension of reading. In the process of comprehending and learning from written material, students need to be rewarded for taking risks and speculating about

meaning as well as relating how a passage may have a specific meaning for them. The classroom environment needs to be a supportive one if students are to risk being wrong in the sense that another interpretation may be better supported by the evidence in the text. When students are asked to give their evidence, or tap the process by which they came to their interpretation, we may begin to help students to develop these processes instead of telling them their answers are wrong, period. In the process of comprehending and learning, learning how to learn, students may begin to enjoy reading for its own sake.

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